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DIMENSION STONE

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Mr. Taylor, a physical scientist with 26 years of industry, Federal Government, and U.S. Bureau of Mines experience, has been the commodity specialist for dimension stone since 1981. Domestic survey data were prepared by Robin Richardson, statistical assistant.

Production of dimension stone increased slightly to 1.14 million short tons valued at $197 million. More than one-half of the dimension stone produced was granite. Limestone, marble, sandstone, and slate were also produced.

Exports of dimension stone increased 20% in value to $65 million. The value of dimension stone imports for consumption decreased 19% to $475 million, equivalent to 241% of the value of domestic production.

DOMESTIC DATA COVERAGE

Domestic production data for dimension stone are developed by the U.S. Bureau of Mines from voluntary surveys of U.S. producers of rough and finished dimension stone. Of the 368 dimension stone operations surveyed for 1991, including those that were idle, 328, or 89%, responded, representing 96% of the estimated value shown in table 1. Production data for nonrespondents were estimated using preliminary production reports, adjusted prior years' production levels, and employment data. *(See table 1.)*

BACKGROUND

Definitions, Grades, and Specifications

Dimension stone is a natural rock material that has been selected, trimmed, or cut to specified or indicated shapes or sizes, with or without one or more mechanically dressed surfaces. This includes rough stone, rubble, ashlar, blocks, panel, and curvilinear shapes. Finished surface requirements may vary from a controlled fractured surface to ground and polished. The most prominent required qualities of dimension stone are strength, toughness, hardness, and resistance to environmmental damage. Color and grain structure contribute largely to price and marketability. The principal types of dimension stone used in construction are granite, marble, limestone, sandstone, and slate.

Stone classification by type in the dimension stone industry is somewhat ambiguous and does not correspond in some repects with the same terms used in mineralological rock descriptions. The U.S. Bureau of Mines generally accepts the classification reported by producers. Granite includes all feldspathic crystalline rocks of predominantly interlocking texture and with mineral grains visible to the naked eye; these include igneous and metamorphic rocks, including quartz diorites, syenites, quartz porphyries, gabbros, anorthosites, and gneisses. White, gray, black, pink, and red are the common colors for granite, but greens, browns, and other shades are produced in some localities.

Limestone includes dolomitic types as well as calcitic. The latter contains less than 5% magnesium carbonate ($MgCO_3$). Dolomitic limestone contains 5% to 40% $MgCO_3$. Marble is a recrystallized (metamorphosed) limestone containing grains of calcite or dolomite or both. In commercial usage, it is any calcareous crystalline rock or serpentine, a hydrous magnesium silicate, capable of taking a polish. Travertine is a type of marble similar to onyx except that it is precipitated from warm or hot water; it has a banded cellular structure and contains cavities up to one-half inch in width that are lined with microstalactites. Dark green serpentines are classified as marble in the industry because they are often crisscrossed with marblelike veinlets of lighter materials, chiefly calcite or dolomite, and because of their ability to take a high polish.

Commercial sandstone is a sedimentary rock consisting mostly of quartz, sometimes with feldspar, or rock fragments of clastic texture bonded by silica, clay, calcite, or iron oxide. Bluestone is a dense, hard, fine-grained feldspathic sandstone that splits easily along a plane into thin, smooth slabs. It is commonly dark or slate gray in color, and its name no longer has color significance. Brownstone is a feldspathic sandstone of brown reddish-brown color caused by abundant interstitial iron oxide. Flagstone may be either a sandstone or a slate that splits into large, thin slabs.

Quartzite is a metamorphic equivalent of sandstone that has been firmly cemented by secondary silica or by recrystallization so that it is essentially homogeneous and fractures through rather than around the original sand grains.

Slate is a fine-grained metamorphic rock derived from shale, siltstone, or claystone. It has prominent cleavage that is oriented independently from the original sedimentary bedding. Mineral constituents are quartz, mica, sericite, or chlorite with assorted minor accessories. Shale is composed mostly of original clay minerals, and cleavage is parallel to the bedding.

Traprock is a commercial term for all dark, igneous rocks too fine in grain size

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to be called black granite. In addition to extrusive flow rocks such as basalt, andesite, or dacite, traprock includes intrusive igneous rocks such as diabase, diorites, gabbros, pyroxenites, amphibolites, and peridotites.

Miscellaneous stones used for dimension purposes include schist, scoria, soapstone, wollastonite, argillite, and many others.

Geology-Resources

Domestic resources of most types of dimension stone used in construction are practically unlimited. There is considerable interstate transportation of certain types of stone such as Indiana limestone, Georgia marble and granite, and Vermont granite, marble, and slate. A lack of deposits of certain specific varieties of dimension stone especially noted for their aesthetic qualities in architecture and artifact manufacture is an important cause of importation of these varieties; for example, brightly colored marbles from Italy.

Technology

Mining.—Present mining methods range from antiquated and very inefficient, which is rather uncommon nowadays, to modern and technically superior. Quarrying methods include use of various combinations of diamond saws, wire saws, diamond wire saws, chain saws, channeling machines, drilling machines, wedges, and broaching tools. The choice of equipment depends on the type of dimension stone, size and shape of deposit, production capacity, labor costs, economics, and management investment attitudes.

Little blasting is done in the mining of dimension stone. Blocks cut from the face are sawed or split into smaller or thinner blocks for ease in transportation and handling and taken to processing plants, commonly at the quarry site, for final cutting and finishing operations.

Processing.—Stone-sawing equipment includes large circular saws 10 feet or more in diameter, usually with diamond inserts; diamond circular saws of smaller size; and reciprocating diamond-bladed or loose-abrasive gang saws for multiple cuts. Various types of diamond and other equipment are used for smoothing, polishing, edging, and decorating the finished stone products. *(See table 2.)*

Economic Factors

The depletion allowance for dimension stone is 14%. Dimension stone quarries are generally in mountainous or hilly areas remote from areas of dense population. Because land use for other purposes is limited, the cost of land is reasonable.

Transportation costs for dimension stone are high because of its weight and because special handling methods are required to prevent damage to the finished stone. A single stone panel broken in transit not only results in the loss of the many employee-hours of skilled labor required to produce it, but also can cause construction delays that are even more costly. Nevertheless, dimension stone is routinely shipped long distances by motor and rail freight, and special domestic varieties are shipped by ocean freight to foreign countries.

Operating Factors

Environmental requirements vary from State to State and are often a cause of conflict between State or local governments and the quarry operators.

Stone primary and waste products are not toxic, nor are the supplies utilized in their production. However, sufficient exposure to silica-rich stone dust can cause silicosis.

The approximate number of employees in the dimension stone industry by stone kind are granite, 9,600; limestone, 1,100; marble, 1,500; slate, 950; and sandstone and other dimension stone, 850. Of the total 14,000, about 3,100 are employed in quarrying and approximately 10,900 in finishing operations. Major States for employment were Georgia with 2,100 employees, Vermont with 1,700, Minnesota with 1,250, North Carolina with 850, Texas with 700, and Indiana with 650.

Fuel is used to power quarrying equipment, and electricity is used for sawing and finishing. Water is used in some quarries to cool equipment such as chain saws and in sawing and finishing plants to cool the equipment; water consumption is relatively minimal in all instances.

ANNUAL REVIEW

Production

Dimension stone was produced by 185 companies at 279 quarries in 35 States, including Puerto Rico. Leading States, in order of tonnage, were Indiana, Georgia, and Vermont, together producing 40% of the Nation's total. Of the total production by tonnage, 51% was granite, 28% was limestone, 11% was sandstone, 3% was slate, 4% was marble, and the remaining 3% was miscellaneous stone. Miscellaneous stone included argillite, schist, soapstone, and traprock (basalt). Leading producing companies, in terms of tonnage, were Cold Spring Granite Co., principally in California, Minnesota, South Dakota, and Texas; Rock of Ages Corp. in New Hampshire and Vermont; and Fletcher Granite Co., Inc., in Massachusetts and New Hampshire.

Granite.—Dimension granite includes all coarse-grained igneous rocks. Production decreased 8% to 585,300 tons and decreased 16% in value to $97.8 million. Granite was produced by 58 companies at 104 quarries in 19 States. Georgia continued to be the leading State, producing 30% of the U.S. total, followed by Vermont and Massachusetts. These three States together produced more than 54% of the U.S. total. Cold Spring Granite, Rock of Ages, and Fletcher Granite were the leading producers and accounted for 47% of U.S. production by tonnage.

Limestone.—Dimension limestone includes bituminous, dolomitic, and siliceous limestones. It was produced by

33 companies at 39 quarries in 12 states. Indiana, the leading State, was followed by Wisconsin and Texas. Leading producers were Indiana Limestone Co. Inc., Independent Limestone Co., and Victor Oolitic Stone Co. The top three companies accounted for 31% of U.S. output.

Marble.—Dimension marble includes certain hard limestones, travertines, and any other calcareous stone that can be polished. Dimension marble was produced by 13 companies at 15 quarries in 11 States, including Puerto Rico. Colorado, Georgia, and Vermont, in order of tonnage, were the three leading States, accounting for approximately 73% of U.S. output. Leading producers were Colorado Yule Marble Co., Georgia Marble Co., and Vermont Marble Co. The top three companies accounted for 72% of U.S. output.

The major news in marble this year was the addition of a new domestic producer and the major expansion of two almost-new producers. The production of the Colorado Yule Marble Co. rapidly expanded as it came more fully on-stream. The product will be used in the new Denver Airport. Sizable amounts of rough blocks are being exported to Italy and Japan.

Dixie Marble, Inc. has opened a quarry near Sylacauga, AL, for Alabama marble. The quarry is producing a white, a gray, and two white with gray veining marbles. Diamond wire saws and diamond belt saws are being used in the quarry to cut out the rough blocks. Reserves will last 150 years at the present rate of quarrying. The firm is also producing four shades of Tennessee marble and buying rough blocks of several colors of Arkansas marble. These marbles are being made into tile by the Armstar plant in Lenoir City, TN. The firm is planning to add some gangsaws and a finishing plant for tiles and slabs later. This represents a substantial increase in the number of colors of domestic marbles currently available, particularly counting the new Puerto Rican marbles.

The Puerto Rican operations of Marmoles Vassco, Inc., of Ponce, Puerto Rico, really hit their stride this year, now that the new equipment is almost all beyond the startup phase. The quarrying operation presently supplies a number of colors, to which will be added a black marble when a new quarry comes on-stream. The marble is quarried by diamond wire saws. The finishing plant has a capacity of 120,000 square feet per month of tile. Thin (5/8 inch) bush-hammered tile is also produced. The firm also can produce structural items such as window sills, thresholds, and risers, plus tables and countertops. It now has 80 employees, up from 7 in 1988. The firm is considering exporting rough blocks, perhaps to Italy.

Sandstone.—Dimension sandstone includes calcareous- and siliceous-cemented sandstones or conglomerates. Quartzite, which is also included, may be described as any siliceous-cemented sandstone. It was produced by 30 companies at 55 quarries in 16 States. The leading three States were, in order of volume, Ohio, Arizona, and New York. Western State Stone Co., Inc., Briar Hill Stone Co., and Waller Bros. Stone Co. were the leading producers and accounted for 44% of U.S. production. In addition to the quantities shown in table 7, dimension quartzite totaled 16,766 tons worth $1,340,000.

Slate.—Dimension slate was produced by 20 companies at 25 quarries in 7 States. The two leading States, Vermont and Pennsylvania, in order of volume, accounted for 69% of U.S. output. The top three producers, A. Dally and Sons Inc., LeSueur-Richmond Slate Co. Inc., and Alfred McAlpine Inc., accounted for an estimated 44% of U.S. output by volume.

Miscellaneous Stone.—Miscellaneous dimension stone, including traprock, was produced by five companies from six quarries in four States and totaled 15,643 tons value at $1,351,000. *(See tables 3, 4, 5, 6, and 7.)*

Consumption and Uses

Dimension stone was marketed over wide areas. Industry stockpiles were not monitored, and production during 1989 was assumed to equal consumption.

Consumption of domestic dimension stone increased slightly to 1.14 million tons valued at $197.1 million. Ashlars and partially squared, dressed pieces were 21% of the total value of consumption, followed by rough monumental stone with 15%; slabs and blocks for building and construction with 14%; dressed monumental stone with 14%; and other uses, 24%.

Of the total consumption of domestic granite, 31% by value was rough monumental stone, 18% was dressed monumental stone, 17% was ashlars and partially squared pieces, and 17% was curbing.

Consumption of domestic limestone totaled 316,982 tons valued at $45.4 million, of which 43% was ashlars and partially squared pieces, 25% was rough blocks for building and construction, and 19% by value was dressed slabs and blocks for building and construction. The change in ashlar from previous years reflects shifts in building practice to veneer and a shift in reporting.

Limestone tile is an important new product that is rapidly gaining popularity. For several years now, tiles made out of hard limestone have sometimes been used as substitutes for other stones, particularly granite tile. These tiles (or slabs) have sometimes been domestic, but more commonly were French or Spanish limestones. They were used in applications where granite or marble are customarily used. Now tile of softer limestones are being made and sold. Specific applications known include some flooring areas not subject to heavy traffic or grit-bearing footwear. *(See tables 8, 9, 10, 11, 12, and 13.)*

In a long-enduring trend before 1980, building dimension stone was replaced to a large extent by concrete, glass, brick, stainless steel, aluminum, porcelain-enameled steel, and plastics. These materials are used in the manufacture of modern mass-produced building modules

and precast building panels. The installed cost of many of these alternate materials has been lower than that of stone. Since 1980, stone has been increasingly preferred for more dignified buildings where its architectural adaptability, permanence, and prestige are of prime importance. A movement back to stone has occurred because of the greater impact of rising energy costs on these substitutes. Resin-bonded stone panels made from stone chips are becoming an important substitute for dimension stone.

Slate has to meet competition from many sources. As a roofing material, alternates such as sheet metal, wood shingles, asbestos-cement shingles, and tile are available. For blackboards, it competes with colored glass, porcelain-enameled steel, and special painted surfaces.

Prices

The average price for dimension stone increased to $173 per ton, down slightly from $177 in 1990.

Foreign Trade

Exports.—Exports of dimension stone, more than 50% of which was granite, increased 21% in value.

Imports.—Imports for consumption of dimension stone decreased 19% in value to $475 million, mostly because of decreases in imports of several major categories of dimension stone, particularly marble slabs, for the second year in a row. Imports of dressed marble slabs, mostly from Italy, decreased 50% to $74 million. On a value basis, marble accounted for 50% of imports, followed by granite at 33%. *(See tables 14, 15, 16, and 17.)*

World Review

Dimension stone is quarried in the great majority of nations in the world. As usual, Italy produced about one-half of the world production. The major importing countries were the United States and Japan; and for rough stone, also Italy. Other significant producers were Brazil, China, Finland, India, Norway, Portugal, Spain, Sweden, Turkey, and the United States.

A major review of world dimension stone markets appeared this year. The statistics are of particular interest. For example, Italy accounted for 25.9% of world dimension stone exports in 1990, Spain, 8.6%; India, 7.4%; the Republic of South Africa, 7.2%; China, 5.9%; Republic of Korea, 5.5%; Portugal, 5.3%; and Brazil, 5.2%. When world dimension stone consumption is considered by application, flooring applications account for 35.2%. In addition, external building facing accounted for 22.8%, funeral products (monumental) for 14.7%, stairs and halls for 7.2%, structural works for 7.2%, internal building facing for 5.2%, and the balance in other applications. The outlook stated was positive, considering the trend toward stone and away from competing materials, changing technology leading to new uses, and supply restrictions in many countries outside North America and Western Europe caused by increased pressure to reclaim closed quarries.[1]

A major review of world slate markets appeared in the same source. The increased interest in dimension stone in the 1980's has also helped the slate industry. At the same time, many firms have undertaken considerable modernization programs, often involving saws. While much more of the production is done by machinery, roofing slate and most other products are still split by hand. Spain produces about 440,000 to 500,000 tons of roofing slate per year, of which 30,000 tons is consumed domestically. France produces about 50,000 tons of roofing slate per year, the United Kingdom about 39,000 tons, and the Federal Republic of Germany about 20,000 tons. Production in all these countries expanded to a marked degree during the 1980's. The importance of Brazil, China, and India is increasing in world slate markets. Usage of waste slate is much higher in Europe than America, such as in road aggregate, roofing granules, and fillers.[2]

Finland.—A thorough review of the Finnish dimension stone industry recently indicated that it was steadily expanding and doing quite well, particularly granite and soapstone. The granite is mostly quarried in the area surrounding Helsinki, particularly to the west. Most of the soapstone is quarried near Juuka, about 200 miles northeast of Helsinki. The largest granite producer is Finska Stenindustri Ab, and the largest soapstone producer is Suomen Vuolukivi Oy (Tulikivi). The great majority of the granite is exported, almost all as rough blocks. Most of the soapstone is made into stoves, fireplaces, and architectural products and used domestically. The rest of the soapstone is exported as these same finished products. The granite industry is opening new quarries that will broaden the range of colors available. The soapstone industry will continue to respond to the growing domestic demand as well as the export demand.[3]

Hungary.—Centurion Mining PLC of London and the Hungarian Investment Co. Ltd. have jointly and equally bought a one-half interest in state-owned Kofargo. Kofargo will now be only one-half state-owned and will be subdivided into Pannon Marble Industries and Renaissance Stone Masonry Co. Pannon Marble's Sutto Div. will own and operate three red marble quarries, five travertine quarries, and four finishing plants for slab and tile. Pannon's Siklos Div. will operate three quarries that produce pink, yellow, cream, green, and gray marbles and a limestone and operate a finishing plant for tile. Renaissance Stone Masonry will operate a finishing plant for ashlar, architectural products, and sculptural work. It will also provide masonry and renovation expertise.

India.—Exports of Indian dimension stone have grown rapidly in recent years: in 1986-87 it was 600 million Rupees and in 1989-90 it was 1,520 million Rupees (1,470 of this being granite). More than

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